

What is claimed is:

1. An image reading apparatus comprising:
  - a detecting surface on which a detecting object is placed;
  - a sensor array having a plurality of sensors arranged to read an image pattern of the detecting
  - 5 object placed on the detecting surface;
  - a first detection electrode, provided on at least an upper portion of the sensor array, having the detecting surface;
  - a second detection electrode provided to be electrically insulated and spaced from the first detection electrode;
  - 10 a counter electrode provided to be opposite to the first detection electrode through an interlayer insulating film;
  - signal voltage applying circuit which applies a signal voltage having a first signal waveform that varies periodically to the counter electrode to excite a second signal waveform to the first detection electrode through the interlayer insulating film; and
  - 15 contact detector which determines whether the detecting object brought into contact with the detecting surface is a specific detecting object based on a third signal waveform excited to the second detection electrode according to contact of the detecting object with both the first detection electrode and the second electrode.
2. The image reading apparatus according to claim 1, further comprising drive
- 20 controller which supplies a predetermined drive control signal to each sensor of the sensor array to perform an image reading operation of the image pattern of the detecting object placed on the detecting surface.
3. The image reading apparatus according to claim 2, wherein the drive controller controls the image reading operation based on the determination result of whether the detecting
- 25 object is the specific detecting object by the contact detector.
4. The image reading apparatus according to claim 1, wherein each sensor of the sensor array is a photosensor, and the first detection electrode and interlayer insulating film have

transmittance.

5. The image reading apparatus according to claim 4, wherein the first detection electrode is a transparent conductive film formed on the upper portion of a light receiving surface of at least the sensor array through the interlayer insulting film.

5 6. The image reading apparatus according to claim 5, wherein the transparent conductive film is formed of material principally of indium - tin oxide.

7. The image reading apparatus according to claim 1, wherein the first detection electrode is a conductive film formed on the upper portion of the sensor array, and the second detection electrode is conductive member formed close to at least a part of the surrounding of the  
10 conductive film.

8. The image reading apparatus according to claim 7, wherein the conductive member is a conductive case member that surrounds around the sensor array.

9. The image reading apparatus according to claim 1, wherein the specific detecting object is a human body, and the image pattern peculiar to the relevant human is read.

15 10. The image reading apparatus according to claim 1, wherein the detecting object is arranged to be laid across the first detection electrode and the second detection electrode to be brought into contact therewith.

11. The image reading apparatus according to claim 1, further comprising amplitude limiting circuit which defines the upper and lower limit voltage values of the second signal  
20 waveform excited to the first detection electrode.

12. The image reading apparatus according to claim 11, wherein the amplitude limiting circuit includes at least an anti-parallel diode circuit provided between the first detection electrode and a ground potential, and defines the upper and lower limit voltage values of the second signal waveform excited to the first detection electrode based on forward voltages of the respective diodes  
25 that form the anti-parallel diode circuit.

13. The image reading apparatus according to claim 1, wherein the signal voltage applying circuit applies a voltage component having a periodical pulse-like signal waveform with

predetermined voltage amplitude to the counter electrode.

14. The image reading apparatus according to claim 1, wherein the contact detector determines whether the detecting object is the specific detecting object based on a value of voltage amplitude and a value of central voltage of the voltage amplitude of the third signal waveform  
5 excited to the second detection electrode.

15. The image reading apparatus according to claim 1, wherein the contact detector determines whether the detecting object is the specific detecting object based on comparison between threshold voltage preset based on a capacitance component and a resistance component of the specific detecting object and the third signal waveform excited to the second detection electrode.

10 16. The image reading apparatus according to claim 15, wherein the contact detector determines that the detecting object is the specific detecting object when the threshold voltage is included within a range of the voltage amplitude of the third signal waveform excited to the second detection electrode.

15 17. The image reading apparatus according to claim 15, wherein the threshold voltage is set to voltage higher than the upper limit value of the third signal waveform excited to the second detection electrode in a state that at least the detecting object comes in no contact with the detecting surface.

18. The image reading apparatus according to claim 15, wherein the threshold voltage is set to voltage lower than the lower limit value of the third signal waveform excited to the second  
20 detection electrode in a state that at least the detecting object comes in no contact with the detecting surface.

19. The image reading apparatus according to claim 15, wherein the contact detector includes at least a threshold voltage setting circuit that sets the threshold voltage, and a comprising circuit that compares the threshold voltage and the third signal waveform.

25 20. The image reading apparatus according to claim 19, wherein the contact detector determines whether the threshold voltage is included in the range of the voltage amplitude of the third signal waveform based on the comparison result by the comparing circuit, and outputs a contact

detection signal indicating that the detecting object is the specific detecting object when it is determined that the threshold voltage is included in the range of the voltage amplitude of the third signal waveform.

21. The image reading apparatus according to claim 19, wherein the third signal  
5 waveform is a waveform that varies periodically, and the contact detector includes means for detecting whether the third signal waveform has passed the threshold voltage level, and count circuit which counts the number of times the third signal waveform has passed the threshold voltage level, and outputs a contact detection signal indicating that the detecting object is the specific detecting object when the number of continuous count times by the count circuit exceeds the preset number of  
10 times.

22. The image reading apparatus according to claim 1, wherein the sensors are photosensors, have a source electrode and a drain electrode that are formed to sandwich a channel area formed of a semiconductor layer, and a first gate electrode and a second gate electrode that are formed on at least upper and lower portions of the channel area through each gate insulating film, a  
15 reset pulse is applied to the first gate electrode to initialize the sensors and a precharge pulse is applied to the drain electrode, thereafter a read pulse is applied to the second gate, thereby electrical charge corresponding to the amount of irradiated light is stored in the channel area for charge storing time, which is from the end of initialization to application of the read pulse, and voltage corresponding to the amount of stored charges as output voltage is output to the channel area, and the  
20 image pattern of the detecting object placed on the detecting surface is read based on a difference between signal voltage according to the precharge pulse and the output voltage.

23. The image reading apparatus according to claim 22, wherein the sensors are formed on an insulating substrate having transmittance, a protection insulating film is formed on a side opposite to the insulating substrate of the sensors, and the interlayer insulating film includes the  
25 protection insulating film and the gate insulating film.

24. The image reading apparatus according to claim 23, wherein a transparent conductive film is formed on the protection insulating film, and the first detection electrode is the transparent

conductive film.

25. The image reading apparatus according to claim 22, wherein the counter electrode is the drain electrode, and the first signal voltage applied to the counter electrode by the signal voltage applying circuit is pulse voltage applied to the drain electrode.

5 26. The image reading apparatus according to claim 25, wherein the pulse voltage is the precharge pulse.

27. The image reading apparatus according to claim 22, wherein the sensor array includes a plurality of drain lines connected to the drain electrode of the photosensors, the counter electrode is the drain electrode and the drain line, and the first signal voltage applied to the counter  
10 electrode by the signal voltage applying circuit is pulse voltage applied to the drain line.

28. The image reading apparatus according to claim 27, wherein the pulse voltage is the precharge pulse.

29. The image reading apparatus according to claim 1, wherein a time constant, which is defined by a resistance component between the detecting surface and the ground potential and a  
15 capacitance component added to the detecting surface, is set to  $0.3 \mu$  sec or a smaller value.

30. The image reading apparatus according to claim 29, wherein the resistance component includes electrical resistance of the first detection electrode.

31. The image reading apparatus according to claim 29, wherein the capacitance component includes electrostatic capacitance between the first detection electrode and the counter  
20 electrode opposed through the interlayer insulating film and between the first detection electrode and the sensor.

32. The image reading apparatus according to claim 29, wherein the time constant is set to  $0.25 \mu$  sec or a smaller value.

33. The image reading apparatus according to claim 29, wherein the resistance  
25 component is set to  $30 \Omega$  or a smaller value.

34. The image reading apparatus according to claim 29, wherein the capacitance component is set to 10 nF or a smaller capacitance value.

35. The image reading apparatus according to claim 29, wherein each sensor of the sensor array is a photosensor and has a predetermined light receiving surface, and the first detection electrode has an area larger than the area of the light receiving surface, and is a transparent electrode film formed on the upper portion of the light receiving surface of the sensor array through the  
5 interlayer insulating film.

36. The image reading apparatus according to claim 35, wherein conductive member having a resistance value lower than a resistance value of the transparent conductive film is provided to be electrically connected to an area besides an area corresponding to at least the light receiving surface of the transparent conductive film.

10 37. The image reading apparatus according to claim 36, wherein the resistance component includes electrical resistance formed by the transparent conductive film and the conductive member.

38. The image reading apparatus according to claim 36, wherein the conductive member is formed of any one of conductive materials of chromium, aluminum, alloy material containing  
15 chromium, and alloy material containing aluminum.

39. A driving method for driving an image reading apparatus including a sensor array having a detecting surface on which a detecting object is placed and drive controller which reads an image pattern of the detecting object placed on the detecting surface, comprising the steps of:

applying signal voltage having a first signal waveform that varies periodically to a counter  
20 electrode provided on an upper portion of the sensor array to be opposite to a first detection electrode having the detecting surface through an interlayer insulating film to excite a second signal waveform to the first detection electrode;

detecting a third signal waveform excited to the second detection electrode based on contact of the detecting object with both the first detection electrode and second detection electrode provided  
25 to be electrically insulated and spaced from the first detection electrode;

determining whether the detecting object brought into contact the detecting surface is a specific detecting object based on the state of the detected third signal waveform; and

starting reading of the image pattern by the drive controller when it is determined that the detecting object is the specific detecting object.

40. The driving method for the image reading apparatus according to claim 39, wherein the step of determining whether the detecting object is a specific detecting object includes the step of  
5 comparing threshold value preset based on a capacitance component and a resistance component of the specific detecting object with the third signal waveform excited to the second detection electrode.

41. The driving method for the image reading apparatus according to claim 40, wherein the step of comparing the threshold voltage with the third signal waveform includes the step of determining whether the threshold voltage is included within the range of voltage amplitude of the  
10 third signal waveform, and the step of determining that the detecting object is the specific detecting object when it is determined that the threshold voltage is included within the range of voltage amplitude of the third signal waveform.

42. The driving method for the image reading apparatus according to claim 40, wherein the step of comparing the threshold voltage with the third signal waveform includes the step of  
15 detecting whether the third signal waveform has passed the threshold voltage level, and the step of determining that the detecting object is the specific detecting object when the number of times the third signal waveform has passed the threshold voltage level is counted and the number of continuous count times exceeds the preset number of times.

43. The driving method for the image reading apparatus according to claim 40, wherein  
20 the threshold voltage is set to voltage higher than the upper limit value of the third signal waveform excited to the second detection electrode in a state that at least the detecting object comes in no contact with the detecting surface.

44. The driving method for the image reading apparatus according to claim 40, wherein the threshold voltage is set to voltage lower than the lower limit value of the third signal waveform  
25 excited to the second detection electrode in a state that at least the detecting object comes in no contact with the detecting surface.